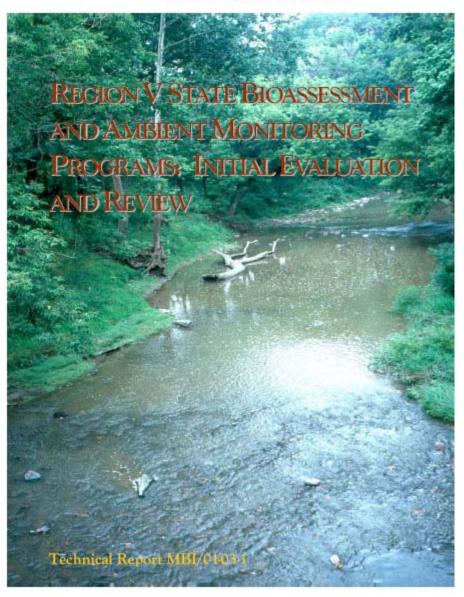


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Region V State Bioassessment and Ambient Monitoring Programs: Initial Evaluation and Review

February 28, 2003 (Revised January 30, 2004)

Final Report

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Key Premise

"... ambient monitoring and assessment should function to support all relevant water quality management programs in addition to its more commonplace role of supporting status assessments."

Key Finding

"M&A program design in some states has been driven predominantly by status."

Purpose and Topics

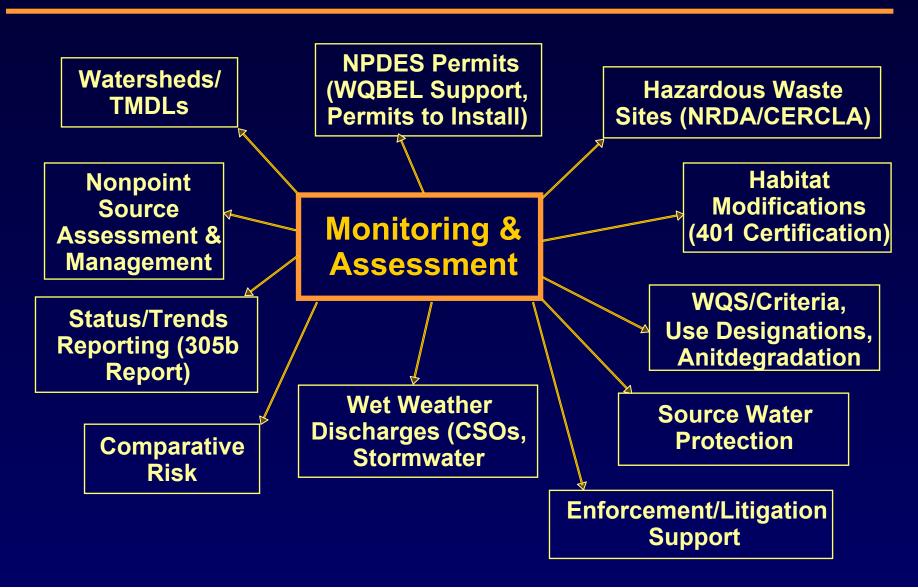
Determine general status of region V State monitoring & assessment programs for ALUS

- Status and Trends
- Reporting and Listing
- Water Quality Standards
- Assessment and Integration
- Biological Assessment & Biocriteria

Goals and Desired Outcomes

- Achieve better integration between monitoring
 & assessment and WQS will foster consistent
 use of M&A in programs
- Better M&A support for all water programs
- Improved delineation along Biocondition Gradient (BCG)
- Refined designated uses benefits to programs
- Improved determination of status and trends

Better Monitoring & Assessment Supports All Water Quality Management Programs



How Is Monitoring & Assessment Affecting Water Quality Management?

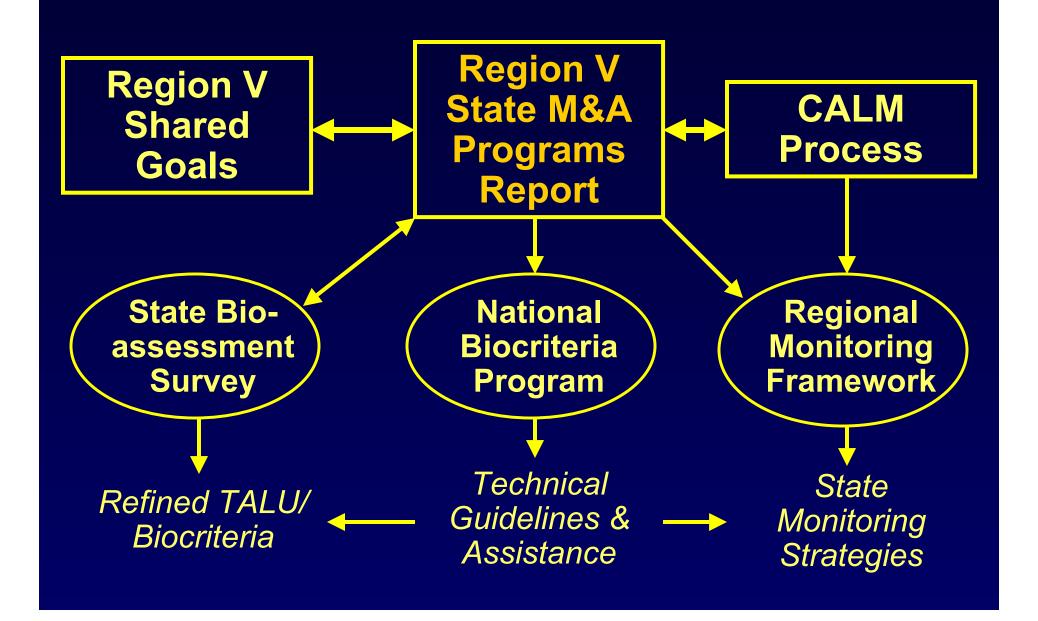
Is the overall approach "adequate"?

- Assessment process
- Indicators ability to measure condition & support inferences about causal relationships
- Resolution pass/fail or continuous gradient?
- Spatial scale issues

Method and Approach

- State interview process January 2002
- Review of State program documentation
- State Bioassessment Programs: Success of EPA's Technical Transfer Efforts and Building State Capacity

Relevancy to Other EPA Issues



Adequate Monitoring & Assessment

Important Precursors & Sources

- ITFM process & resources (NWQMC)
- Important Concepts & Elements . . . Adequate M&A (EPA/ASIWPCA)
- CALM process (EPA)
- National Research Council Science in TMDLs
- Recent EPA developments and leading State program models

National Academy of Sciences Committee to Assess Science in TMDLs¹

Two Major WQ Program Areas Identified as Needing Improvement:

Water Quality Standards

- Refined designated uses
- UAA process
- Biological criteria

Monitoring and Assessment

- "Adequacy" in terms of concepts and elements
- Appropriate roles of ambient indicators

¹NRC (2001). Assessing the TMDL Approach to Water Quality Management

Symptoms of An Incomplete Foundation in Water Quality Management

- General uses and criteria (one-size-fits-all)
- Reliance on prescriptive approaches
- Reliance on anecdotal information
- Emphasis on administrative outcomes
- Point source & pollutant focused translation of concepts to nonpoint sources and TMDLs
- Inconsistent environmental statistics reported between States (305b, 304l, 303d, etc.)
- Gross dissatisfaction with listings (too many, too few)

Fundamental Objectives of Adequate Monitoring and Assessment Approaches

Function: Surface Water Assessment

- Collect and analyze baseline information.
- Establish cause/effect (causal associations).
- Compare results to criteria and goals (use attainment).
- Publish results statewide, regional, site-specific.

Function: WQ Mgmt./Pollution Abatement

- Attainability analyses and criteria development (maintain WQS).
- Formulate and revise abatement strategies (TMDL development).
- Assess effectiveness of programs (WQ Management).

Function: Compliance Evaluation

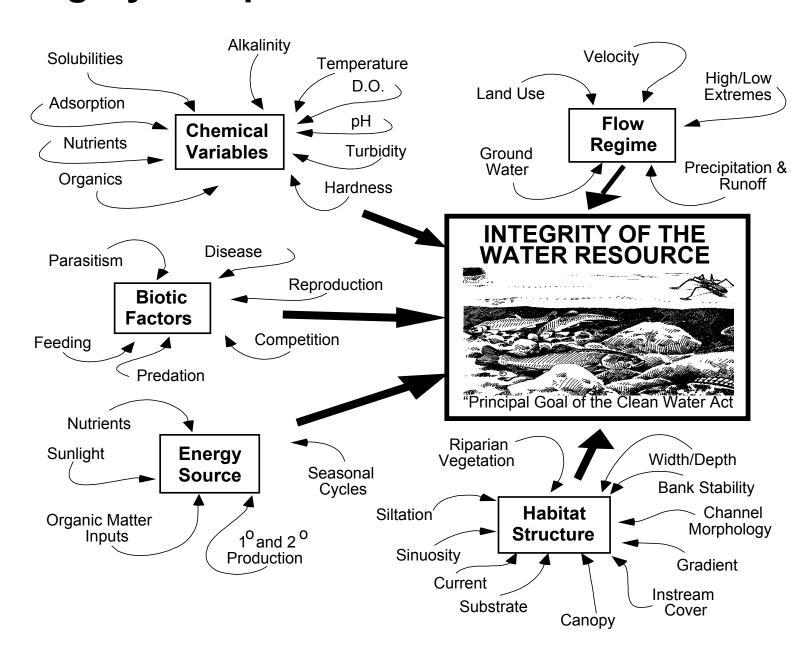
- Monitor to determine compliance.
- Monitor to support enforcement.

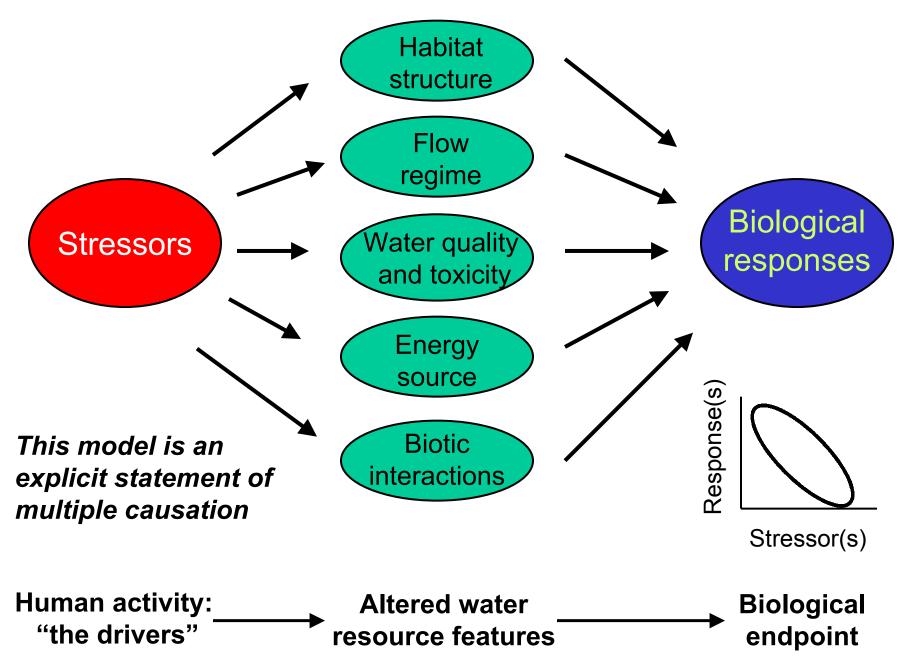
after 40CFR Part 35 (deleted in 1990?)

Conceptual Underpinnings

- Karr's five factors Water Resource Integrity
- Stressor Response model
- Biological condition gradient
- Adequate monitoring & assessment
- Hierarchy of indicators
- Results driven management outcomes
- The Product is an integrated assessment

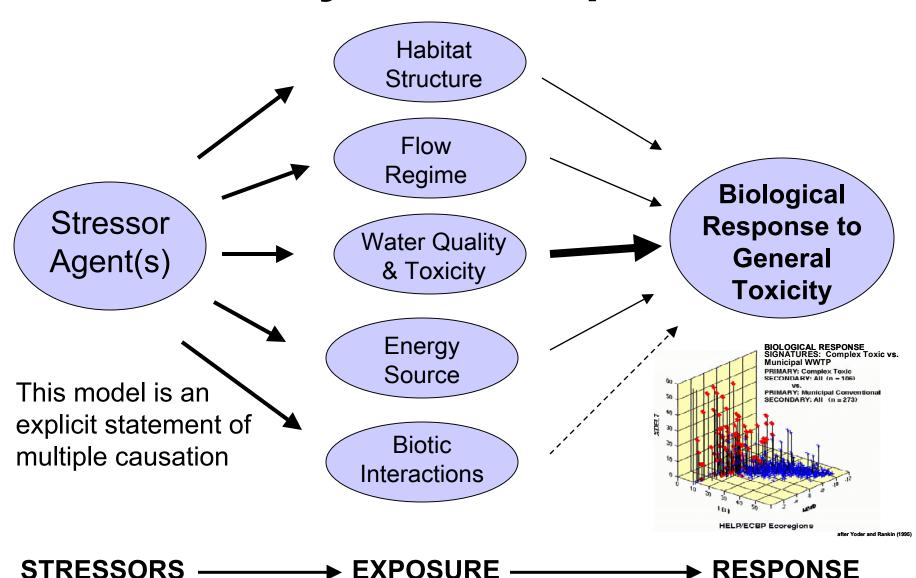
The Five Major Factors Which Determine the Integrity of Aquatic Resources



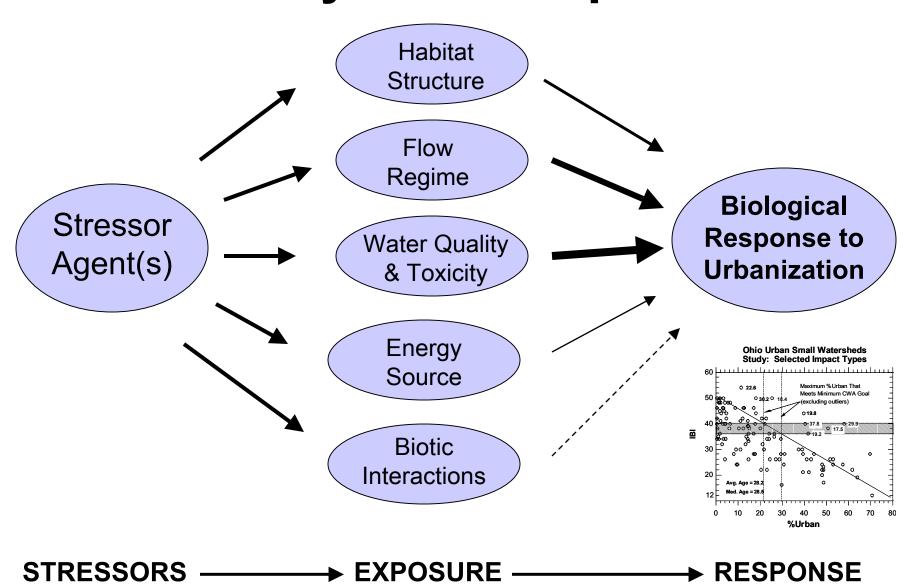


after Karr and Yoder (2004)

The Linkage From Stressor Effects to Ecosystem Response



The Linkage From Stressor Effects to Ecosystem Response



CORE INDICATORS

• Fish Assemblage • Macroinvertebrates • Periphyton (Use Community Level Data From At Least Two)

Physical Habitat Indicators

- Channel morphologyFlow
- Substrate QualityRiparian

Chemical Quality Indicators

- pHTemperature
- Conductivity
 Dissolved O₂

For Specific Designated Uses Add the Following:

AQUATIC LIFE

Base List:

- Ionic strength
- Nutrients, sediment Supplemental List:
- Metals (water/sediment)
- Organics (water/sediment)
- Chlorophyll a

RECREATIONAL

Base List:

- Fecal bacteria
- Ionic strength Supplemental List:
- Other pathogens
- Organics (water/sed.)
- Chlorophyll a

WATER SUPPLY

Base List:

- Fecal bacteria
- lonic strength
- Nutrients, sediment <u>Supplemental List</u>:
- Metals (water/sediment)
- Organics (water/sed.)
- Other pathogens
- Chlorophyll a

HUMAN/WILDLIFE CONSUMPTION Base List:

- Metals (in tissues)
- Organics (in tissues)

Tiered Aquatic Life Use Conceptual Model: Draft Biological Tiers

(10/22 draft)

Sommunity	Natural structural, functional, and taxonomic integrity is preserved. Structure and function similar to natural community with some additional taxa & biomass; no or incidental anomalies; sensitive non-native taxa may be present; ecosystem level functions are fully maintained									
– =	Evident changes in structure due to loss of some rare native taxa; shifts in relative abundance; ecosystem level functions fully maintained through redundant attributes of the system.									
Bio to E	Moderate changes in structure due to replacement of sensitive ubiquitous taxa by more tolerant taxa; overall balanced distribution of all expected taxa; ecosystem functions largely maintained.									
on of the Specific	& propagation threshold Sensitive taxa markedly diminished; conspicuously unbalanced distribution of major groups from that expected; organism condition shows signs of physiological stress; ecosystem function shows reduced complexity and redundancy; increased build up or export of unused materials.									
Condition	Extreme changes in structure; wholesale changes in taxonomic composition; extreme alterations from normal densities; organism condition is often poor; 6 anomalies may be frequent; ecosystem functions are extremely altered.									

LOW — Human Disturbance Gradient — → HIGH

Measuring and Managing Environmental Progress: Hierarchy of Indicators

- 1. Management actions
- 2. Response to management
- 3. Stressor abatement
- 4. Ambient conditions
- 5. Direct exposure to effects of pollution
- 6. Biological response.

Administrative indicators

[permits, plans, grants, enforcement, [technologies used, BMPs installed]

Stressor indicators

[effluent reduction, changes in land-use practices]

Exposure indicators

[pollutant conc., flow or physical habitat alteration, assimilation and uptake of pollutants, reduced spawning habitat, nutrient dynamics changes, sedimentation effects, etc.]

Response indicators

[biological metrics, multimetric indexes, target species, other biological measures]

Endpoint of Concern: "ecological health"

Elements and Concepts of Adequate Watershed Monitoring & Assessment

- Concept driven Karr's five factors
- Cost-effective indicators, yet comprehensive
- Indicator discipline adherence to roles (stress, exposure, response)
- Key indicators tied to WQS (uses and criteria)
- Adapts quickly to improved science & technology
- Adequate resources, facilities, and professionalism
- Spatial design matches scale of management
- Product is the assessment, not just the data

Administrative Outputs vs. Resource Outcomes Based Management

ADMINISTRATIVE OUTPUTS APPROACH

RESOURCE OUTCOMES APPROACH

Goal: Program Performance

(Program execution)

Environmental Performance (Attain designated uses)

Measures: Administrative Actions

(Lists, Permits, Funding,

Rules)

Indicator End-points

(Biological, Chemical, Physical)

Results: Improve Programs

(Reduce backlogs, improve timeliness)

Programs are Tools to Improve the Environment

(Admin. actions evaluated by changes in env. indicators)

Table 2A. Attributes and characteristics of Region V State biological monitoring and assessment programs: Macroinvertebrate field protocols and applications.

State		Sample	e Collection	n Methox	is¹		Field Process Capa- city					Aquatic Ecotypes						
Agency	Quant. Sample	Effort Index	Qual. Sample	Effort Index	Stan- dard- ization	Index Period	Habitat Protocol	Sort	I.D.	#Sites/ Year	Primary HW	Head- water	Wade- able	Large River	Great River	Wet- lands	Lakes/ Res. ²	Great Lakes
IL EPA	Multiple Habitat Dipnet	Sampling Surface Area	Dip Net/Hand Pick	Time (>60 min.)	NO	June 1- Oct. 15	Quanti- tative Transect	NO	Qual only ³	80-120	- 1	-	•	•	ı	-	ı	-
IN DEM	Mod. Hester- Dendy ⁴	Sampling Surface Area	Klak Net (1 m²)	Surface Area	YES	July- Sept.	RBP-type Assess- ment	NO	NO	100	1	•	•	•	ı	0	0	-
MI DEQ	Mod. Hester- Dendy ⁶	Sampling Surface Area	Dip Net/Hand Pick	Time (>30 min.)	YES	June 1 Sept 30	RBP-type Assess- ment	YES	Family level	700	ı	ı	•	ı	NA	-	ı	-
MN PCA	NONE	NA.	D-Net/ Hand Plok	20 sweeps	YES	Septem -ber	RBP-type Assess- ment	NO	NO	90-100	1	•	•	•	-	•	0	-
OH EPA	Mod. Hester- Dendy	Sampling Surface Area	Dip Net/Hand Pick	Time (>30 min.)	YES	July 1- sept 30	Site description (No Index)	NO	Qual only ²	450- 500	•	•	•	•	•	•	ı	•
WI DNR	NO	NA.	D-Net/ Hand Plok	Visual Based (2-3 min.)	YES	Spring/ Fall	Wisconsin Protocol	NO	NO	400	ı	0	•	ı	ı	0	0	-

Method and assessment are fully developed and used and numeric biocriteria are adopted in WQS.

Method and assessment are fully developed and used, but not adopted in WQS (may include general narrative biocriteria).

Method and assessment are in development and in initial phases of usage.

^{- -} Method and assessment are not developed.

Principal methods are in shaded boxes.

² Includes biological assemblage assessments; does not include trophic state and other lake assessments or fishery management surveys.

³ Gross field identification to determine if new taxa are being included.

⁴ Used in lieu of kick net.

⁵ Used historically – no longer a principal method – replaced by qualitative method.

Table 4. Structure and elements of water quality standards (WQS) and procedures related to the use of monitoring and assessment information in Region V States.

State	Aquatic Life Uses		lses Biocriteria ¹⁶			teria Modifica	ations	Biological Monitoring & Assessment Support					
Agency	Structure	Criteria	Narrative Numeric Specific UAAs Other		Use Designa- tions	Designa- Support		TMDL Listings					
IL EPA	General; Non- specific	Numerio Chemical	NONE	NONE	NONE	Limited for AQL (case- specific)	Adjusted Standards Reviews (20-30 total)	NONE	Informal Process (via 305b)	Biological Stream Classification (BSC)	305(b) Monitored Level		
IN DEM	General; Fishery- Based (Warm & Cold water)	Numerio Chemical	Proposed	NONE	5-6 Cases Statewide	Very Limited	NONE	NONE	Informal Process (via 305b)	NONE	Subset of 305(b)		
MI	General; Fishery- Based (Warm & Cold water)	Numerio Chemical	NONE	NONE	6-7 Cases (most for copper)	NONE (no <cwa use<br="">categories available)</cwa>	NONE	NONE	Informal Process (via 305b)	NONE	Close Subset of 305(b)		
MN PCA	General; Fishery- Based (Warm & Cold water) with Limited Use	Numerio Chemical	1994; More specific adopted 2001	NONE	Three cases (ammonia & copper)	Class 7 (Limited Use) designations; 230 segments)	Outstanding Resource Waters	NONE	Informal Process (via 305b)	NONE	Subset of 305(b)		
OH EPA	Tiered Warmwater Uses; Cold water fishery use	Biological & Chemical Criteria	Tiered AQL Use Descrip- tions	YES (Fish and Inverts; adopted 1990)	2 Cases	Routine Outcome of 5 Yr. Basin Process; >1500 since 1978	Biocriteria Caps on DMT; Biocrit. Derivation of ohem crit.	Directly tied to bloassess- ment results	Codfied in WQS via AQL and Blooriteria	Formal oriteria & procedure	Direct translation of 305(b)		
WI DNR	Tiered Uses	Chemical criteria	NONE	NONE	<10 Cases Statewide	Developing Guidance; 104 changes proposed	NONE	Indirectly influenced	Informal Process (via 305b)	NONE	Subset of 305(b)		

¹⁶ Formally adopted in State administrative code or regulations.

Table 5. Attributes and characteristics of Region V State biological monitoring and assessment programs: Watershed and water body assessment process.

State		Watershed Spatial Sampling Design						Assessment Process						
Agency	Temporal	Spetial	Fixed Station	Targeted Synoptic	Targeted Intensive	Prob- ability	Geo- metrio	HUC Unit ²⁹	ALUS ¹⁸ Arbiter	ALUS Delinea- tion ¹⁹	Assessment Chain-of- Custody ²⁰	Site Extra- polation	Cause/ Source	IA/Weight-of- Evidence
IL EPA	Five-Year Rotating Basin Process	Statewide Coverage Every 5 Years	•	•	•	ı	-	8 digit	Biological Assessment	ssment follows (pe		10-25 mi. (per EPA guidance)	Structured process (based on chem./ptys. data)	Weight-of- Evidence
IN DEM	Five-Year Rotating Basin Process	Statewide Coverage Every 5 Years	•	ı	•	•	ı	8 digit	Chemical andfor Biological Assessment	Pass/Fall	Consensus Decision by Study Team	A "few" miles; mostly case specific	Follow EPA guidance; H, M, S	IA tendency
MI DEQ	Five-Year Rotating Basin Process	Assess 80% wadeable in each cycle	•	1	•	ı	ı	11 digit	Biological and/or Chemical Assessment	Pass.Fail (Poor to fail)	Lead Biologist follows established guidance	Case specific (3- 5 mi. max.)	Follow EPA guidenoe; H,M,S	IA
MN PCA	Rotating Basin Process	Statewide coverage by 2007	•	1	•	•	Future Design	8 digit	Chemical & Biological Assessment	Pass/Fall	Consensus Decision by Study Team	Varies (10 ml. on average)	Follow EPA Assessment Database	Weight-of- Evidence
OH EPA	Five-Year Rotating Basin Process	Intensive Coverage of Priority Subbasins	•	ı	•	0	•	11-14 digit	Numerio Biocriteria	Numerio, Increment- al Scale (Biocond. Gradient)	Lead Biologist asst. by Study Team; Mgmt. Approval	Case specific; 0.5-1.0 mi. default	Integrated Process; Lines- of-Evidence; Biol. Response Signatures	Weight-of- Evidence
WI DNR	Five-Year Rotating Basin Proce	Intensive Coverage of Priority Basins	•	1	•	0	-	11 digit	Biological and/or Chemical Assessment	Pass/Fail	Lead Biologist asst. by Study Team	BPJ	Do Not use H,M,S	Weight-of- Evidence

Principal method and design used to support WQ management.

Method/design used in a secondary support role.

O - Method/design used on an infrequent or experimental basis.

Method and assessment are not developed.

Basin size within which watershed specific assessment is most commonly planned and conducted – gets at spatial intensity and resolution within a watershed sampling unit.

Basin size within which watershed specific assessment is most commonly planned and conducted – gets at spatial intensity and resolution within a watershed sampling unit.

Basin size within which watershed specific assessment is most commonly planned and conducted – gets at spatial intensity and resolution within a watershed sampling unit.

Passafail is assigned to 305b delineations of full, partial, non-attainment; incremental scale is assigned for calibrated numeric biocriteria that are fully implemented.

Process for developing site and/or reach assessment.

Table 6. Relative degree to which major water quality management program areas are supported by monitoring and assessment in each of the Region V states.

State	Ba Repo	sic orting							Watersheds/ NPS TMDL/303d				NPDES/Other Permitting							
Agency	Status ²¹	Trend ²²	Tiered Uses	UAA ²⁴	Refined WQC ³⁵	Anti- deg.	Site- Specific Crit.Mod. ²⁶	NPS/BMP Effective- ness	Hab- itat ²⁷	List/ Delist	TMDL Dev. 20	WQ BELs ²⁰	Priority Setting	CSOs/ SSOs	Storm- water Ph. I&II	WET Limits/ Cond. ²¹	Sever- by/ Extent ^{io}	Enforce ment ³³	404/401 Dredge & Fill**	
IL EPA	•	0	1	0	ı	ı	0	0	•	•	0	•	0	0	ı	-	0	•	-	
IN DEM	•	0	ı	0	ı	1	ı	0	0	0	0	0	ı	ı	ı	-	ı	0	-	
MI DEQ	•	0	ı	-	1	-	0	•	•	•	0	•	0	0	-	0	-	0	-	
MN PCA	•	0	-	0	0	-	-	•	0	0	0	0	0	1	-	0	0	0	-	
OH EPA	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
WI DNR	•	0	0	•	ı	0	-	•	•	0	0	0	ı	ı	•	-	•	•	-	

 ⁻ Well developed and routine process for using monitoring & assessment for at least 5-10 years; based on an integrated indicators framework process and comprehensive watershed design.

Process and tools are available, but usage is no longer routine and occurs only on a project or issue specific basis.

Project or site-specific use of monitoring & assessment consisting of upstream/downstream studies, paired stream studies (no comprehensive watershed design).

Occasional or infrequent usage or under development.

No support from ambient monitoring & assessment.

²¹ Basic attainment/non-attainment assessment for aquatic life use status including delineation of causes and sources of threat and impairment.

Sufficient information to report aggregate status of ecotypes over at least a 10 year period; does not refer to analysis of fixed station chemical trends.

Tiered uses that are developed based on assemblage assessments and which correspond to EPA's biological condition axis; does not include fishery based or general uses.

²⁴ Includes any use of ambient monitoring data to change designated uses, both "upgrades" and "downgrades".

²⁵ Ambient data is used to develop water quality criteria and/or influence the application or implementation of WQC (exclusive of pH, hardness, and other single modifiers).

²⁸ Ambient survey data is used to ground truth EPA's site specific criteria process (water effects ratio).

²⁷ Habitat assessment is linked to biological assessment and listed as a cause of impairment.

²⁰ Includes using ambient data to support TMDL development and determine success of TMDL implementation beyond basic calibration data.

Water quality based effluent limits – ambient data is used to develop an assessment of the overall effect of the subject discharge on the receiving waters.

³⁰ Ambient data is used to influence priority setting for NPDES permitting and/or SRF funding priorities.

³¹ Ambient survey data is used to develop WET testing requirements and/or effluent limits in NPDES permits.

³² Assessment framework allows for determination of incremental departures and changes beyond pass/fail and communicates severity of problem over space & time.

³³ Direct use of ambient survey data to support enforcement in terms of demonstrating that action is both legal and reasonable.

Direct support of general policy and site-specific decisions for the 401 certification of 404 dredge and fill permits.

Initial Findings

- All states have M&A programs resources vary
- Status assessment drives some M&A programs
- Others emphasize program support
- Only one state reports aggregate trends
- One state with true tiered uses, one with multiple fishery uses, four with general uses
- Priority on administrative outcomes
- All states have biological programs vary widely
- Biocriteria development issues
- Incentives and disincentives

Next Steps and Tasks

- Use report as a tool to work with States to deal with issues identified by the report
- Expand work with State biological assessment working group expand tech. transfer
- Technical assistance to States: March May '04
- Applied research on key issues
- Involvement in national program (TALU/BCG, bioassessment technical elements, CALM, etc.)